

Math 108 — Epidemiology — Prof. Kaplan  
Final Exam

December 15, 2010

## Multiple Choice

- Epidemiology is the study of the ... FILL IN THE BLANK ... of health-related states or events in human populations and application of this study to controlling health problems.
  - cause and effect
  - distribution and determinants
  - science and efficacy
  - function and process
  - None of the above is correct.
- Which of the following is **NOT** an activity of descriptive epidemiology?
  - Monitoring health-related states or events over time.
  - Monitoring potential exposures over time.
  - Evaluating the effects of an assigned intervention on an outcome of interest.
  - Understanding where and when the health problem is greatest.
  - All of these are activities of descriptive epidemiology.
- Which of the following terms refers to a persistent, expected level of disease in a defined population?  
epidemic outbreak endemic pandemic
- The disease-evoking power of a pathogen is called which of the following?  
invasiveness variability virulence communicability
- The likelihood of a pathogen or agent being transmitted from one infected person to another susceptible person is referred to as which of the following?  
invasiveness variability virulence communicability
- The natural course of communicable disease involves a susceptible host; a point of exposure; a subclinical disease phase; the clinical disease phase; and a phase of recovery, disability, or death. Which phase is related to the latency period?
  - Susceptibility phase
  - Subclinical phase
  - Clinical disease phase
  - Recovery, disability, or death phase
- WHAT refers to an error that occurs if it is mistakenly assumed that, because the majority of a group has a characteristic, the characteristic is associated with those experiencing the outcome?
  - Bias
  - Ecologic fallacy
  - Confounding
  - Chance
- Match the following as a **descriptive** or an **analytic** epidemiological study.
  - Who descriptive analytic
  - Why descriptive analytic
  - How descriptive analytic
  - What descriptive analytic
  - When descriptive analytic
  - Where descriptive analytic
- Which of the following statistics is the most appropriate measure to use when investigating a disease outbreak?
  - Prevalence proportion
  - Mortality rate
  - Attack rate
  - Attributable risk percent
- The outbreak of an illness among football players and coaches is hypothesized to be associated with a person's location — the north versus the south wing — in an athletic training center. Each player and coach was asked where he was practicing, resulting in the following  $2 \times 2$  table.
 

	Illness	
Location	Yes	No
South	25	13
North	5	15

Use an appropriate measure to calculate the association between location and illness.

1.2 2.6 3.0 4.9 5.0
- Overestimation bias of the case fatality ratio is most likely to occur because of which of the following?
  - Overreporting of cases
  - Underreporting of less serious cases
  - Poor case definition
  - Imprecise diagnostic procedures
- Which measure is best for monitoring changes in the risk of disease in a population over time?
  - Crude rate
  - Relative risk
  - Rate ratio
  - Age-adjusted rate
- Suppose you wanted to monitor the trend in age-adjusted incidence rates of breast cancer over the calendar years 1980 through 2000. Which of the following standard populations is the most appropriate for adjusting the rates throughout this period?

- ☐ A 1980
- ☐ B 1990
- ☐ C 2000
- ☐ D It does not matter.

14. In Los Angeles, public health authorities identified 100 people with disease X. These cases came from 40 affected households with 230 people. Assuming that each household had only one primary case and that each primary case attended a local daycare center, what is the secondary attack rate?

- ☐ A 32%
- ☐ B 17%
- ☐ C 43%
- ☐ D 67%

15. Which of the following best defines external validity?

- ☐ A The component of accuracy reflecting the level of systematic error in the study
- ☐ B The extent to which the results of a study are relevant to people who are not part of the study
- ☐ C The extent to which the results of the study are not attributable to bias or confounding
- ☐ D Two of the above describe external validity.

16. How can confounding be controlled for at the **design level** of a case-control study?

- ☐ A Matching
- ☐ B Multiple regression
- ☐ C Stratification

17. How can confounding be controlled for at the **analysis level** of a case-control study?

- ☐ A Matching
- ☐ B Stratification
- ☐ C Case definition

18. Why is a randomized, blinded experimental study best for establishing cause-effect relationships?

- ☐ A Randomization balances out the effects of confounding factors.
- ☐ B The study design establishes a time sequence of events.
- ☐ C Blinding can minimize bias.
- ☐ D All of the above.

19. What is the primary limitation of using a non-randomized clinical trial?

- ☐ A Not effective at controlling for **measured** confounding variables.
- ☐ B Not effective at controlling for **unmeasured** confounding variables.
- ☐ C Patients may be assigned to an intervention group to which they prefer not to be assigned.
- ☐ D A comparison group is not available.

20. What can be said of confounding if there is no association between the exposure and the purported confounder?

- ☐ A There is a positive confounding effect.
- ☐ B There is a negative confounding effect.
- ☐ C There is no confounding effect.
- ☐ D The confounding effect is influenced by effect modification.

21. Which best classifies an epidemic if the epidemic curve shows a rapid rise, peak, and gradual decrease?





- ☐ A Propagated
- ☐ B Continuous source
- ☐ C Intermittent source
- ☐ D Point source

22. Answer these true-or-false questions.

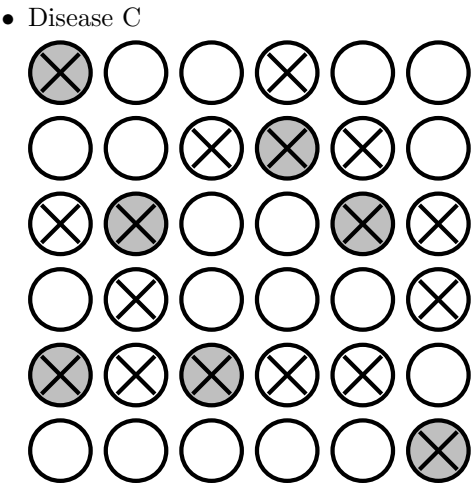
- (a) Cancer screening is a form of primary prevention. True False
- (b) The ecologic study design is a useful approach for measuring the association between exposure and disease at the individual level. True False
- (c) Incidence is a better measure of disease risk than prevalence. True False
- (d) If the disease is common, the odds ratio will approximately equal the risk ratio. True False
- (e) In a case-control study, the ratio of cases to controls should always be 1:1. True False

23. The diagrams below show different diseases along with exposure to some hypothesized cause.

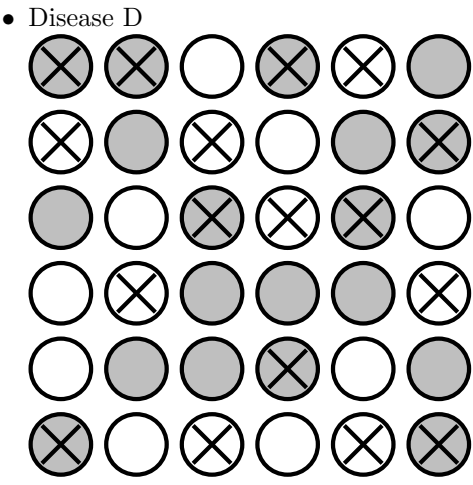
**Key:** Each circle is a person who might or might not have been exposed to the hypothetical cause and who might or might not have eventually acquired the disease.

- Exposed but not sick 
- Sick 
- Exposed and Sick 
- Neither exposed nor sick 

For each of the diseases, say whether the exposure is a necessary and/or sufficient cause for development of the disease.



- For Disease C
- ☐ A Necessary but not sufficient
  - ☐ B Sufficient but not necessary
  - ☐ C Necessary and Sufficient
  - ☐ D Neither necessary nor sufficient



- For Disease D
- ☐ A Necessary but not sufficient
  - ☐ B Sufficient but not necessary
  - ☐ C Necessary and Sufficient
  - ☐ D Neither necessary nor sufficient

## Short Answer

A screening test for a newly discovered disease is being evaluated. In order to determine the effectiveness of the new test, it was administered to 900 workers.

150 of the individuals diagnosed with the disease tested positive. A negative test finding occurred in 60 people who had the disease. A total of 50 persons not diseased tested positive for it.

1. Draw the appropriate  $2 \times 2$  table to represent the above information. Double check it to make sure that you have it right.

For each of the following, choose the best answer. You may also want to show your answer in terms of the numbers you entered in the table, for example in the form 60/150.

2. What is the prevalence of disease cases in the population?  

<input type="checkbox"/> A	77%
<input type="checkbox"/> B	75%
<input type="checkbox"/> C	9%
<input type="checkbox"/> D	23%
<input type="checkbox"/> E	Can't be determined from the information given.

3. What is the sensitivity of the test?

- |                            |       |
|----------------------------|-------|
| <input type="checkbox"/> A | 71.4% |
| <input type="checkbox"/> B | 74.0% |
| <input type="checkbox"/> C | 92.8% |
| <input type="checkbox"/> D | 23.3% |

4. What is the specificity of the test?

- |                            |       |
|----------------------------|-------|
| <input type="checkbox"/> A | 46.9% |
| <input type="checkbox"/> B | 89.3% |
| <input type="checkbox"/> C | 92.8% |
| <input type="checkbox"/> D | 27.8% |

5. What is the overall accuracy of the test?

- |                            |     |
|----------------------------|-----|
| <input type="checkbox"/> A | 71% |
| <input type="checkbox"/> B | 75% |
| <input type="checkbox"/> C | 78% |
| <input type="checkbox"/> D | 88% |

6. What is the predictive value of a positive test? (Positive predictive value.)

- |                            |       |
|----------------------------|-------|
| <input type="checkbox"/> A | 53.8% |
| <input type="checkbox"/> B | 71.1% |
| <input type="checkbox"/> C | 78.8% |
| <input type="checkbox"/> D | 75.0% |

7. What is the predictive value of a negative test? (Negative predictive value.)

- |                            |       |
|----------------------------|-------|
| <input type="checkbox"/> A | 76.7% |
| <input type="checkbox"/> B | 88.8% |
| <input type="checkbox"/> C | 91.4% |
| <input type="checkbox"/> D | 92.8% |

8. Say whether "accuracy" is a good measure of the effectiveness of a diagnostic test. Explain why or why not.

# Essays

## Essay 1

You have been asked to provide a judgment on the feasibility of eradicating an infectious disease. What features of a disease will make it easier or harder to eradicate? Use smallpox as a reference, pointing out what aspects of smallpox facilitated its eradication and how another disease might differ.

## Essay 2

Here is part of an op-ed essay in the New York *Times*: Nicholas Kristof, “Cancer from the kitchen?” Dec. 5, 2009. Read it, then answer the question posed at the bottom.

This last week I attended a fascinating symposium at Mount Sinai School of Medicine in New York, exploring whether certain common chemicals are linked to breast cancer and other ailments.

Dr. Philip Landrigan, the chairman of the department of preventive medicine at Mount Sinai, said that the risk that a 50-year-old white woman will develop breast cancer has soared to 12 percent today, from 1 percent in 1975. (Some of that is probably a result of better detection.) Younger people also seem to be developing breast cancer: This year a 10-year-old in California, Hannah, is fighting breast cancer and recording her struggle on a blog.

Likewise, asthma rates have tripled over the last 25 years, Dr. Landrigan said. Childhood leukemia is increasing by 1 percent per year. Obesity has surged. One factor may be lifestyle changes — like less physical exercise and more stress and fast food — but some chemicals may also play a role.

Take breast cancer. One puzzle has been that most women living in Asia have low rates of breast cancer, but ethnic Asian women born and raised in the United States don’t enjoy that benefit. At the symposium, Dr. Alisan Goldfarb, a surgeon specializing in breast cancer, pointed to a chart showing breast cancer rates by ethnicity.

“If an Asian woman moves to New York, her daughters will be in this column,” she said, pointing to “whites.” “It is something to do with the environment.”

What’s happening? One theory starts with the well-known fact that women with more lifetime menstrual cycles are at greater risk for breast cancer, because they’re exposed to more estrogen. For

example, a woman who began menstruating before 12 has a 30 percent greater risk of breast cancer than one who began at 15 or later.

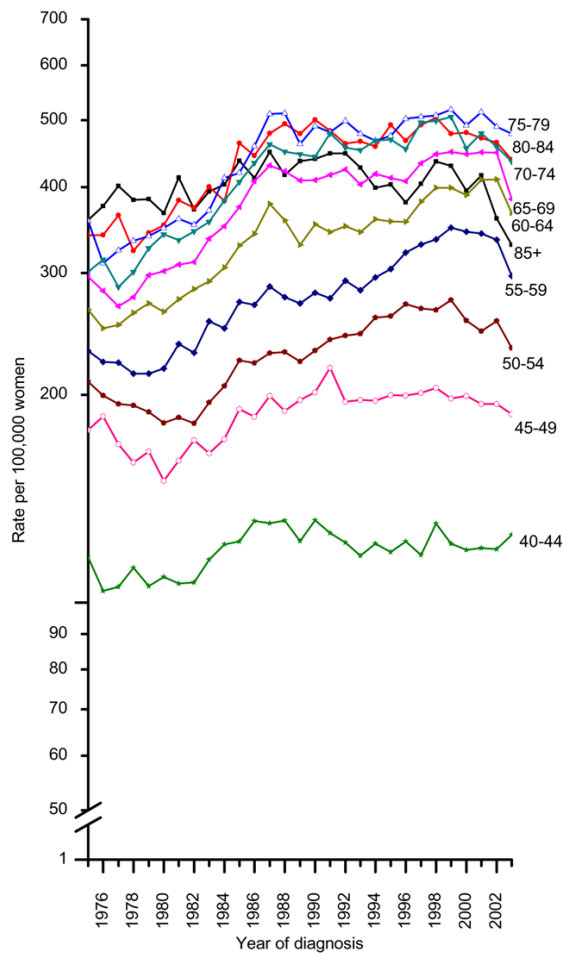
It’s also well established that Western women are beginning puberty earlier, and going through menopause later. Dr. Maida Galvez, a pediatrician who runs Mount Sinai’s pediatric environmental health specialty unit, told the symposium that American girls in the year 1800 had their first period, on average, at about age 17. By 1900 that had dropped to 14. Now it is 12.

A number of studies, mostly in animals, have linked early puberty to exposure to pesticides, P.C.B.’s and other chemicals. One class of chemicals that creates concern — although the evidence is not definitive — is endocrine disruptors, which are often similar to estrogen and may fool the body into setting off hormonal changes. This used to be a fringe theory, but it is now being treated with great seriousness by the Endocrine Society, the professional association of hormone specialists in the United States.

These endocrine disruptors are found in everything from certain plastics to various cosmetics. “There’s a ton of stuff around that has estrogenic material in it,” Dr. Goldfarb said. “There’s makeup that you rub into your skin for a youthful appearance that is really estrogen.”

Your boss has asked you to do a quick evaluation of the increase from 1 percent to 12 percent cited in the essay.

In doing some background research, you find the following graph of age-specific **invasive** breast cancer incidence rates among women 40 years old and above, from 1975 to 2003. (Source: Jemal *et al.* (2007) *Breast Cancer Research* 9:R28.)



Also, with an Internet search you find that mammography started to become available in the mid 1970s, and that the current age-adjusted incidence rate for white women is 126 per 100,000 women per year, while the death rate is 23.4 per 100,000 per year.

- Using this information, **as well as any other knowledge you have that bears on the issue**, outline in one or two paragraphs what factors other than “common chemicals” might account for the dramatic increase in breast cancer rates cited in the article.
- Describe in one or two paragraphs a reasonable design for a study to investigate the possible link between “common chemicals” and breast cancer. Assume that you would need to have the study results in one or two years. If there are serious fundamental obstacles to designing a reasonable study, say what they are. (By “fundamental” obstacles, I do **not** mean problems with getting funding or getting access to existing data.)